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EAR FALLS GS - FOUNDATION INVESTIGATION

Report No 89-134-K

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Abstract

An investigation of the bedrock foundation at Ear Falls Generating Station was undertaken. This program involved the drilling of boreholes through the powerhouse floor, logging the core, examining the boreholes with a borehole camera and taking water levels. Recommendations to monitor the performance of the bedrock foundation have been provided.

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To Mr. R.A. Wright
Manager - SHARP
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Attention: Mr. I. Azis

EAR FALLS GS - FOUNDATION INVESTIGATION

1.0 INTRODUCTION

An investigation was undertaken at Ear Falls GS to determine the condition of the concrete and rock foundation beneath the powerhouse floor during a period extending from November 8 to 21, 1988. The program involved drilling a series of boreholes through the concrete and into the bedrock below, logging the concrete and rock core, and inspecting the boreholes with a closed circuit borehole television camera. This report provides an assessment of the rock foundation. The concrete assessment has been conducted by the Concrete Technology Section and is discussed in a separate report.

2.0 FIELD INVESTIGATION

A total of six vertical N-sized boreholes were drilled through the floor of the Ear Falls GS powerhouse and are shown in plan view in Figure 1. These holes were drilled using a BBVA air drill supplied by a 750 Sullair compressor. Drill water was obtained from the fire water supply system and captured in a water-sealed wood box which was built around the drill hole collar in the powerhouse floor. The water in the box was then pumped through an open window to the tailrace with the aid of a ground fault protected 120 volt electric pump. Prior to the drilling of all anchor holes and boreholes, approval was obtained from the Electrical Foreman to ensure that no concrete-embedded electrical cables would be intercepted during the drilling process.

Drilling commenced at Borehole 4, located between units 3 and 4 (Figure 5) and was terminated at a depth of 61.5 ft (18.7 m). The concrete/rock interface was intercepted at 47.3 ft (14.4 m) and the static water level was measured at a depth of 12.3 ft (3.7 m). The second hole drilled was Borehole 3, located between units 2 and 3 (Figure 4) and drilled to a depth of 71.9 ft (21.9 m). The concrete/rock interface was located at 49.1 ft (15.0 m) and the static water level at 13.0 ft (4.0 m) The third hole drilled was Borehole 2, located between units 1 and 2 (Figure 3) and drilled to a depth of 71.9 ft (21.9 m).

The concrete/rock interface was located at 47.6 ft (14.5 m) and the static water level at 12.8 ft (3.9 m). The fourth hole drilled was Borehole 5, located northeast of Unit 4 (Figure 6) and drilled to a depth of 54.2 ft (16.5 m). The concrete/rock interface was located at 28.1 ft (8.6 m) and the static water level at 9.8 ft (3.0 m). The fifth hole drilled was Borehole 1 located west of Unit 1 (Figure 2) and drilled to a depth of 40.8 ft (12.4 m) with the concrete/rock contact at 37.3 ft (11.4 m). This hole was abandoned after the core barrel became lodged in the borehole and removed with extreme difficulty. The replacement hole was Borehole 6, which was located east of unit 1 and north of Borehole 1 (Figure 7). Borehole 6 was drilled to a depth of 51.6 ft (15.7 m). The concrete/rock interface was intersected at 36.4 ft (11.1 m) and the static water level at 13.0 ft (4.0 m).

Subsequent to the drilling program, all holes except for borehole 1 were viewed with a closed circuit borehole television camera. Borehole 1 was not examined for fear of damaging the equipment in the zone where the core barrel retrieval problems occurred. The rock core from all boreholes was sent to the Research Laboratory for detailed logging. A sample of the material that was found at the bottom of borehole 1 was retained for examination. The top 12 inches (30.5 cm) or so of each borehole was grouted upon completion of the project.

3.0 DISCUSSION

All concrete and rock cores were photographed and are included in a separate report issued by the Concrete Technology Section. Appendix A of this report provides detailed borehole logs for boreholes 1 to 6. The Rock Quality Designation (RQD) for Boreholes 2, 3, 4 and 5 is generally in the fair to excellent ranges with poor zones only appearing at the top of boreholes 2 and 4. This lower rating results from the denser rock joints appearing immediately below the concrete/rock contact. Many of these joints are stained indicating that they are open and probably contain flowing water. The concrete/rock contact in Borehole 3 is open, while contacts in boreholes 2, 4, and 5 are all tight contacts, even though the contact in Borehole 5 was slightly stained (rust-brown).

Borehole 4 went from concrete into bedrock, back into concrete and into bedrock once more. It would appear that the bedrock was irregular and that when the concrete was poured it was placed both above and below the rock extrusion.

Boreholes 1 and 6 show poor rock quality designation values. The concrete/rock interface in Borehole 6 is tightly bonded and appears that way in the extracted core. The concrete/rock interface in Borehole 1 is not known, since this hole was not examined with the borehole television camera.

The highest concentration of stained joints in the rock mass occurred within a 10 ft (3 m) zone immediately below the concrete/rock contact. TV camera investigations indicate the possibility of water flow as well as murky water

conditions in this zone. Water levels measured in each hole also suggest that the structure is experiencing piezometric levels closely equal to the tailrace water level. The sample taken from the bottom of Borehole 1 contained material (ie sand, silt, gravel, wood) indicative of an external source (ie tailrace).

4.0 SUMMARY

The rock foundation beneath the Ear Falls Generating Station has been examined and noted to be performing adequately at this time. There is no visible indication of slippage or settlement between the concrete structure and the rock foundation. However, based on the assumption that the plant will be in operation for at least 30 years, the long-term integrity of the rock mass immediately below the concrete/rock interface (ie 10 ft/(3m)) is of some concern. This zone is characterized by closely-spaced, open, stained joints with very poor to fair rock quality and a potential for high flow rates based on drill water intakes. Recommendations to address this concern are provided below.

5.0 RECOMMENDATIONS

1. In an effort to evaluate the potential for future rock deterioration resulting from possible water movement in the rock mass immediately below the dam, it is recommended that flow velocities be measured in the boreholes at selected locations. It would be advisable to repeat these readings at specified intervals to determine whether flow rates are increasing with time. Increases in flow rates could indicate increases in rock mass deterioration.

2. It is suggested that a visual examination of the rock mass, with emphasis on potential flow zones, be undertaken with the aid of a borehole TV camera at the time of the flow measurements. This may provide an indication as to whether or not the open zones are increasing in size with time. The water levels in the boreholes should also be measured at this time.

3. The sample taken from Borehole 1 should be analyzed in greater detail in an effort to determine its origin (ie headpond, tailrace, etc.). The direction of flow in this zone may also help in this determination.

4. From a safety point of view, it is recommended that air drills are not used inside of manned stations due to the high noise levels that they can generate.

6.0 ACKNOWLEDGMENTS

We wish to thank Mr. Bill Coulson, Mr. Wayne Ross and the staff of the Ear Falls Generating Station for their excellent support and co-operation during the investigation program.

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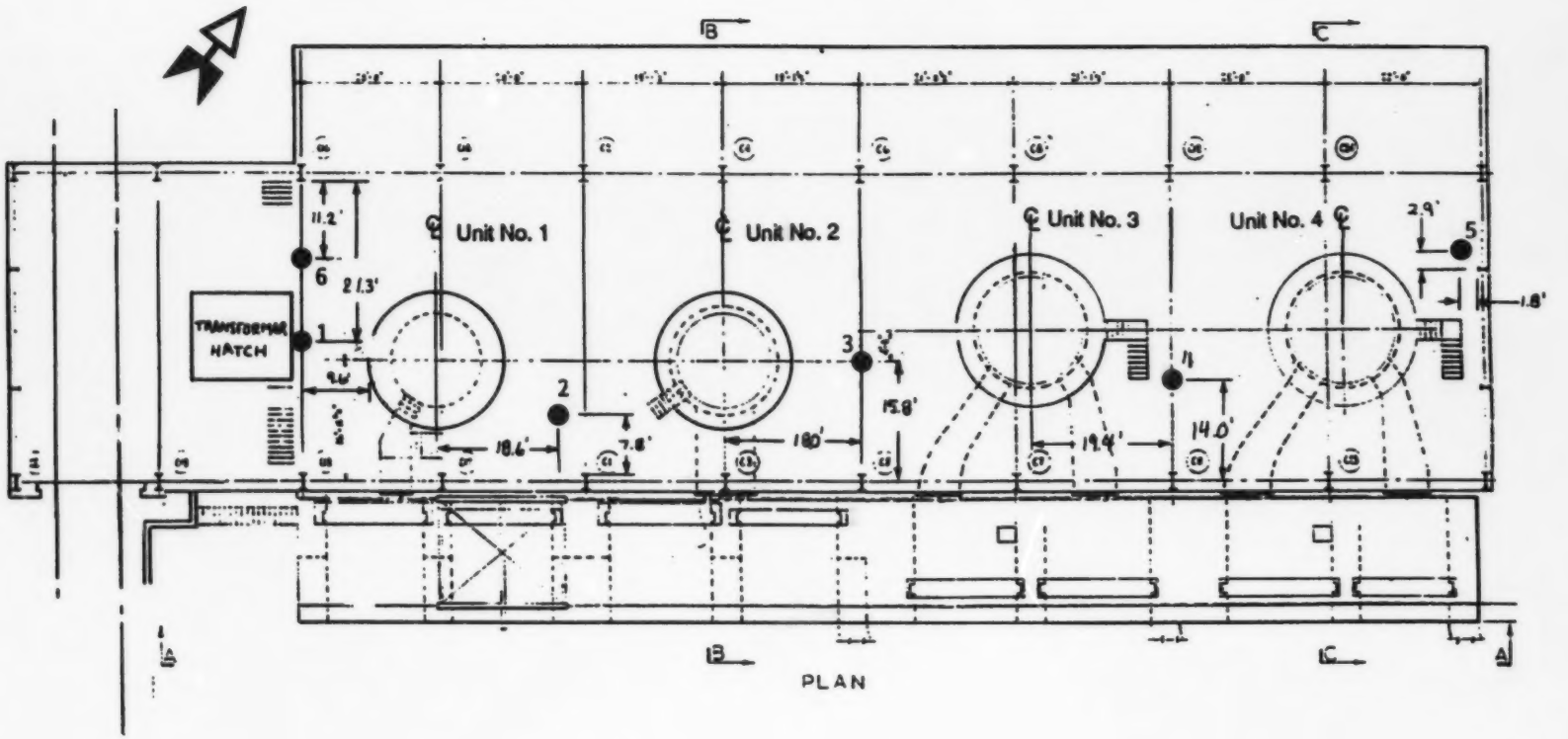
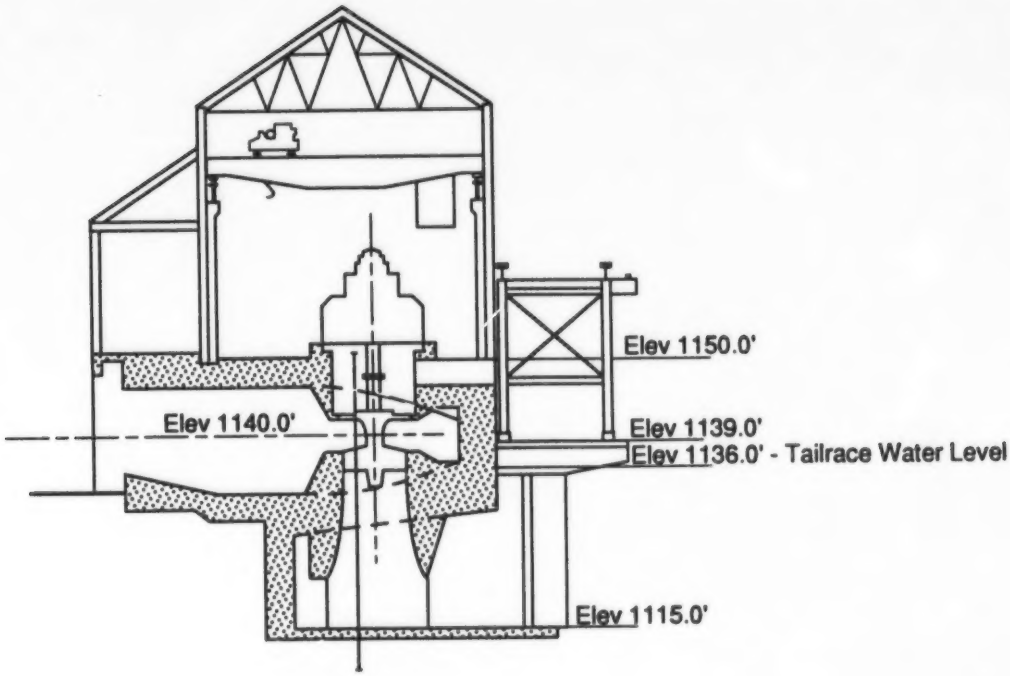


FIGURE 1

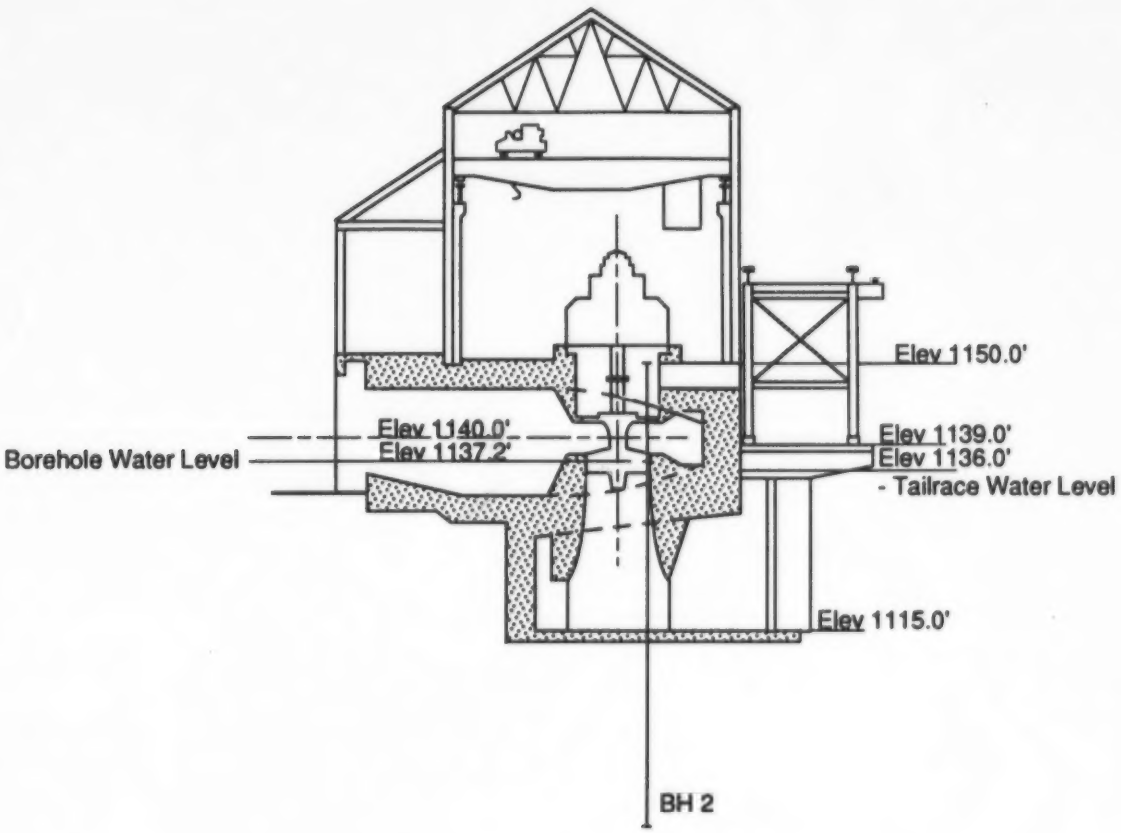
PLAN VIEW SHOWING BOREHOLE LOCATIONS
(Reference Drawing No. 39-d-509)



DEPTH (ft)	FEATURE
0.0	Powerhouse Floor
37.3	Concrete/rock Interface
40.8	Bottom of Hole

FIGURE 2

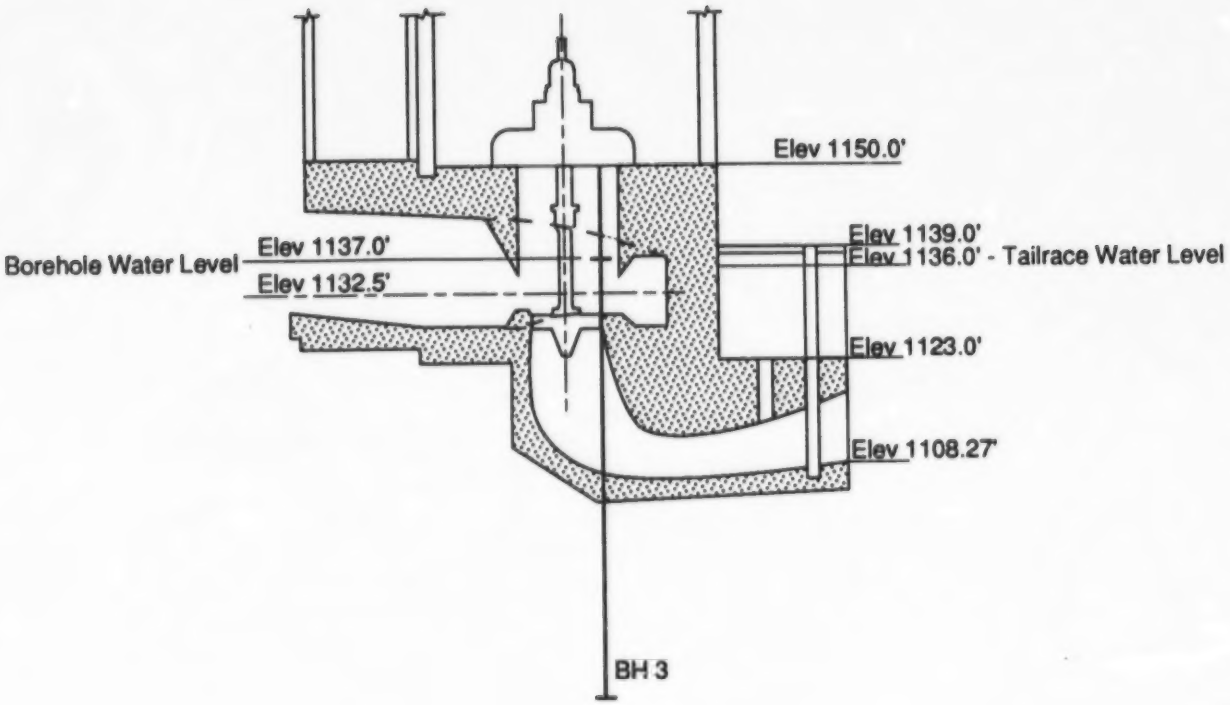
CROSS-SECTION SHOWING APPROXIMATE LOCATION OF BOREHOLE 1 SOUTHWEST OF UNIT NO 1



DEPTH (ft)	FEATURE
0.0	Powerhouse Floor
12.8	Water Level
47.6	Concrete/rock Interface
71.9	Bottom of Hole

FIGURE 3

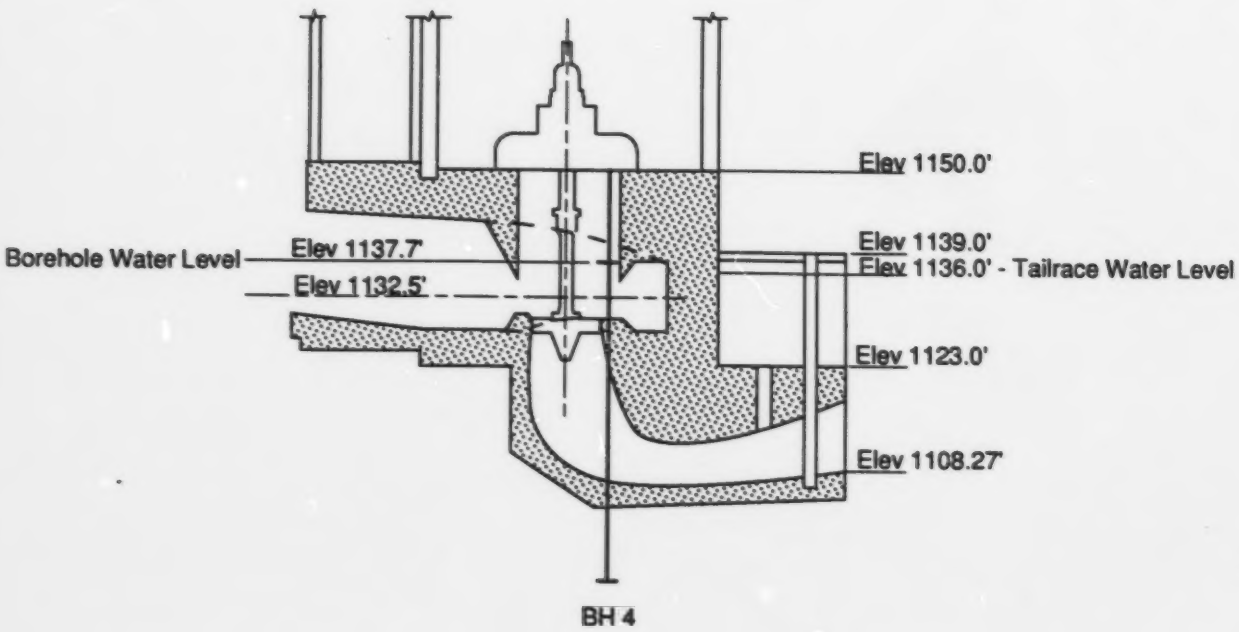
CROSS-SECTION SHOWING APPROXIMATE LOCATION OF BOREHOLE 2 EAST OF UNIT NO 1



DEPTH (ft)	FEATURE
0.0	Powerhouse Floor
13.0	Water Level
49.1	Concrete/rock Interface
71.9	Bottom of Hole

FIGURE 4

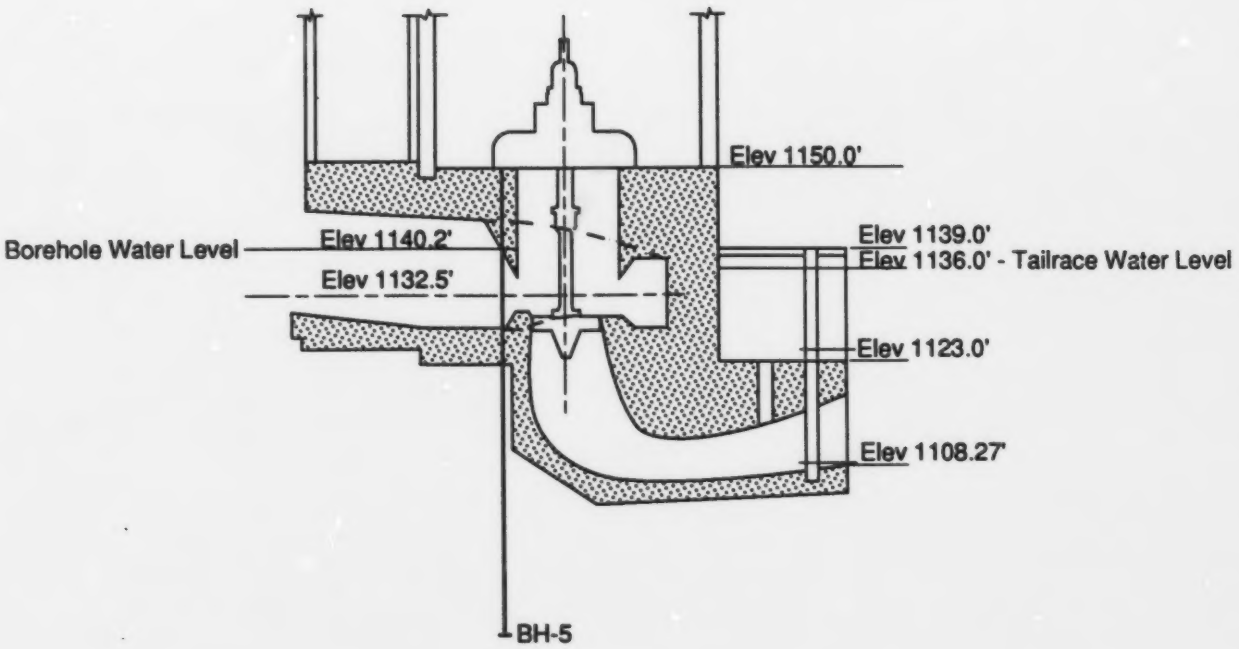
CROSS-SECTION SHOWING APPROXIMATE LOCATION OF BOREHOLE 3 EAST OF UNIT NO 2



DEPTH (ft)	FEATURE
0.0	Powerhouse Floor
12.3	Water Level
47.3	Concrete/rock Interface
61.5	Bottom of Hole

FIGURE 5

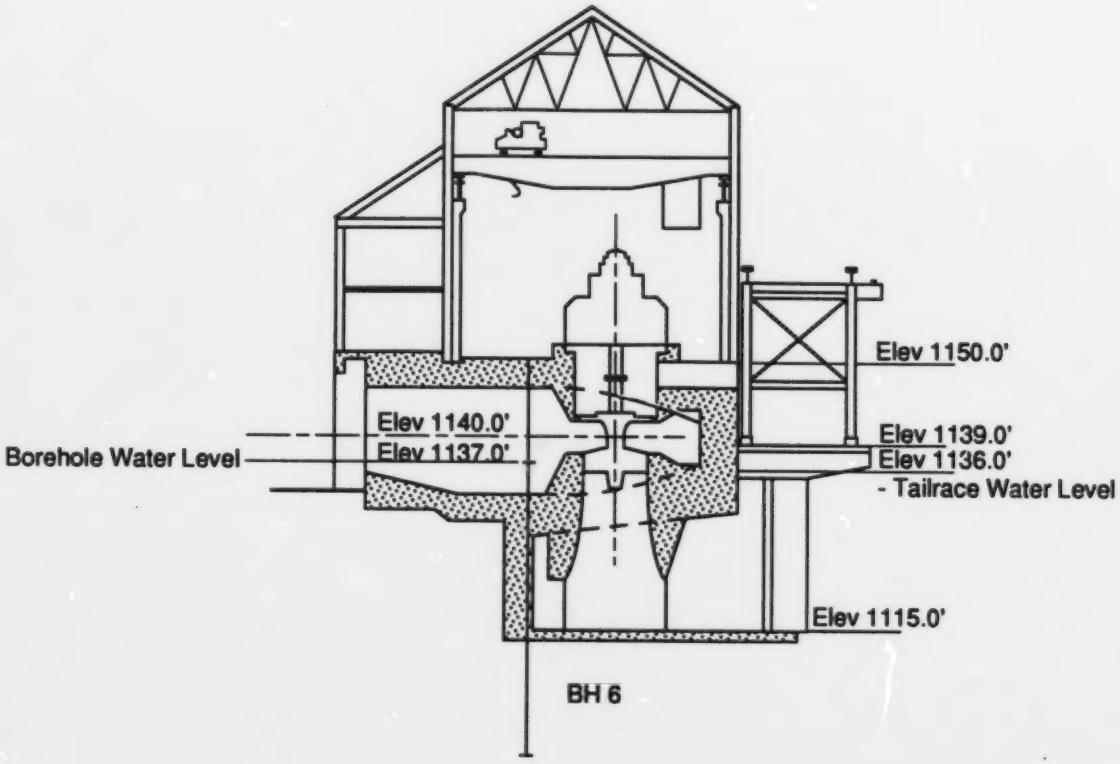
CROSS-SECTION SHOWING APPROXIMATE LOCATION OF BOREHOLE 4 EAST OF UNIT NO 3



DEPTH (ft)	FEATURE
0.0	Powerhouse Floor
9.8	Water Level
28.1	Concrete/rock Interface
54.2	Bottom of Hole

FIGURE 6

CROSS-SECTION SHOWING APPROXIMATE LOCATION OF BOREHOLE 5 NORTH-EAST OF UNIT NO 4



DEPTH (ft)	FEATURE
0.0	Powerhouse Floor
13.0	Water Level
36.4	Concrete/rock Interface
51.6	Bottom of Hole

FIGURE 7

CROSS-SECTION SHOWING APPROXIMATE LOCATION OF BOREHOLE 6 WEST OF UNIT NO 6

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APPENDIX A

DETAILED DRILL CORE LOGGING

PROJECT..Ear Falls Generating Station.....PROJECT NO.....

SITE ....Powerhouse Floor.....HOLE NO...1.....

....Bedrock - Medium Grey Gneiss.....SHEET NO.1...OF.1.....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
0.0	concrete floor														
0.0 to 37.3	concrete														
37.3	concrete/rock interface														
37.4	joint (rust brown)	80°			X	X					X				
37.8	joint (rust brown)	30°			X	X					X				
38.0	joint (rust brown)	80°			X	X					X				
37.7 to 38.3	joint (rust brown)	10°			X	X					X				
38.3	joint (rust brown)	85°			X	X					X				
38.7	joint (rust brown)	80°			X	X					X				
38.7 to 38.9	joint (rust brn,calcified)	35°			X	X					X				21%
39.0	joint (rust brown)	45°			X	X					X				
39.2	joint (rust brown)	65°			X	X					X				
39.3	joint	80°			X	X									
39.5	joint (rust brown)	80°			X	X					X				
39.8	joint (rust brn, pyrite)	85°			X	X					X				
39.8 to 40.3	joint (rust brown)	0°			X	X					X				
40.1	joint	90°			X			X							
40.3	joint	85°			X	X									
40.8	end of hole (mud, sand gravel,etc. found here)														

DETAILED DRILL CORE LOGGING

PROJECT Ear Falls Generating Station ..... PROJECT NO. .....

SITE Powerhouse Floor ..... HOLE NO. 2 .....

Bedrock - Medium Grey Gneiss ..... SHEET NO. 1 OF 3 .....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION													RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING				
0.0 to 47.6	concrete floor															
0.0 to 47.6	concrete															
47.6	concrete/rock interface															
47.7	joint (brown)	80°			X	X					X					
48.1	intersecting joints	80°			X	X										
		70°			X	X										
48.4	joint	80°			X	X										
48.5	joint	80°			X	X										
48.8	joint	80°			X	X										
49.1	joint	75°			X	X		X								
49.3	joint (rust brown)	35°			X	X					X					
49.4	joint (rust brown)	90°			X	X					X					
49.5 to 49.7	joint (rust brown)	25°		X		X					X					
49.9	joint (pyrite)	90°			X	X										
50.5	joint (rust brown)	80°			X	X					X					
50.8	joint	90°			X	X										
50.9	joint	80°			X	X										
51.1	joint	90°			X	X										25%
51.3	joint	90°			X	X										
51.4	joint	90°			X	X										
51.6	joint	80°			X	X										

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DETAILED DRILL CORE LOGGING

PROJECT..Ear Falls Generating Station.....PROJECT NO.....

SITE ....Powerhouse Floor.....HOLE NO...2.....

.....SHEET NO..2..OF..3....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
51.7	joint	80°			X	X									
51.8	joint	90°			X	X									
52.4	joint	90°			X	X									
52.8	joint	90°			X	X									
52.9	joint	90°			X	X									
53.05	joint	90°			X	X									
53.1	joint	90°			X	X									
53.3	joint	90°			X	X									
53.33	joint	90°			X	X									
53.5	joint	90°			X	X									
53.6	joint	90°			X	X									
53.6 to 53.8	clorite schist (soft)														
53.9 to 54.2	void														
54.4	joint	95°			X	X									
54.6	joint (calcified)	80°			X	X									
54.7	joint	80°			X	X									
54.9	joint	90°			X	X									
54.96	joint	90°			X	X									
55.1	joint (pyrite)	60°			X	X									84%
55.5	joint (tight)	80°			X	X									
55.9	joint	90°			X	X									
58.3	joint	80°			X	X									
58.9	reference point														

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DETAILED DRILL CORE LOGGING

PROJECT Ear Falls Generating Station ..... PROJECT NO. .....

SITE Powerhouse Floor ..... HOLE NO. 2 .....

..... SHEET NO. 3 OF 3 ...

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION													RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING				
59.5	joint (tight)	80°			X	X										98%
60.8	joint (tight)	90°			X	X										
61.3	joint (tight)	80°			X	X										
61.8	joint (tight)	80°			X	X										
62.3 to 62.6	joint (pyrite)	25°			X	X										
63.3	joint	70°			X	X										
63.4	joint	50°			X	X										
63.8	joint (calcified)	90°			X	X										
64.4	joint (calcified)	90°			X	X										100%
65.1	joint	80°			X	X										
68.1	joint	80°			X	X										
69.0	joint	30°			X	X										
69.5	joint (tight)	80°			X	X										93%
70.1	joint	90°			X	X										
70.5	joint	70°			X	X										
71.3	joint	90°			X	X										
71.9	end of hole															

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DETAILED DRILL CORE LOGGING

PROJECT.....Ear Falls Generating Station.....PROJECT NO.....

SITE .....Powerhouse Floor.....HOLE NO...3.....

.....Bedrock - Medium Grey Gneiss.....SHEET NO.1..OF.3....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION													RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING				
0.0 to 49.0	concrete floor															
0.0 to 49.0	concrete															
49.0	concrete/rock interface (rough)															
50.5	joint (light brn,calcified)	40°						X			X					100%
51.8	joint (rust brown)	30°			X	X					X					
53.9	reference point															
56.0	joint (chloritized)	75°			X	X					X					
56.4	joint (rust brn, pyrite)	90°						X			X					
56.9	joint (rust brown)	75°			X	X					X					
57.25	joint (rust brown)	75°			X	X					X					
57.3	joint (rust brown)	80°			X			X			X					78%
57.5	joint (rust brown)	75°			X	X					X					
58.4	joint (rust brown)	60°			X	X					X					
58.4 to 58.9	void															
58.9	joint (rust brown)	75°			X	X					X					
58.9 to 59.5	joint (light brown)	0°			X			X			X					
59.3 to 59.8	quartz bed															
59.8	joint (light brown)	70°			X	X					X					

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DETAILED DRILL CORE LOGGING

PROJECT.....Ear Falls Generating Station.....PROJECT NO.....

SITE .....Powerhouse Floor.....HOLE NO..3.....

.....SHEET NO.2...OF.3.....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
59.9	joint	90°			X	X									
60.5	joint (tight)	60°			X	X									
61.2	joint	40°			X	X									
61.4	joint	40°			X	X									
61.8 to 62.0	Quartz (closely broken)														
62.2	joint	90°			X	X									52%
62.4	joint	90°			X	X									
62.5	joint	90°			X	X									
62.6	joint	90°			X	X									
62.8	joint	90°			X	X									
62.9	joint	90°			X	X									
63.0	joint	90°			X	X									
63.0 to 63.5	void														
63.5	joint (yellow brown)	80°			X	X					X				
63.8	joint	90°			X	X									
64.4	reference point														
64.6 to 64.8	joint (green, pyrite)	15°			X			X			X				
65.1	joint (rust brown)	90°			X	X					X				
65.3	joint	90°			X	X									
65.4	joint (light yellow)	80°			X	X					X				
65.5	joint	90°		X		X									
65.8	joint	70°			X			X							
65.83	joint (white, pyrite)	90°									X				

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DETAILED DRILL CORE LOGGING

PROJECT....Ear Falls Generating Station.....PROJECT NO.....

SITE .....Powerhouse Floor.....HOLE NO....3.....

.....SHEET NO.3..OF.3....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
66.7	joint (tight)	80°			X	X									
67.2	joint (light brown)	80°			X	X					X				
67.25	joint	75°			X	X									68%
67.4	joint (light brown)	90°			X	X					X				
67.42	joint (light brown)	70°			X		X				X				
67.6	joint	80°			X		X								
67.4 to 67.6	joint (green)	0°			X	X					X				
68.5	joint (tight)	90°			X	X									
69.2	joint (tight)	90°			X	X									
69.5	joint (calcified)	90°			X	X									
70.7	joint	90°			X	X									79%
70.71	joint	90°			X	X									
71.9	End of hole														

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DETAILED DRILL CORE LOGGING

PROJECT....Ear Falls Generating Station.....PROJECT NO.....

SITE .....Powerhouse Floor.....HOLE NO....4.....

.....Bedrock - Medium Grey Gneiss.....SHEET NO.1...OF.2.....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
0.0	concrete floor														
34.7	concrete/rock interface (brown)	30°			X										
34.7 to 41.0	concrete and rock (concrete stained yellow)														
34.9 to 35.7	joint (carbonaceous)	20°			X					X	X				
41.0 to 47.3	concrete														
47.3	concrete/rock contact (tight)														
47.4 to 47.8	joint	15°			X										
47.9	joint	35°			X										
48.0	joint (brown green)	85°						X			X				
48.3	joint (brown green)	90°			X						X				
48.7	joint (brown green)	90°			X						X				36%
49.3	joint	90°			X										
49.5	joint (brown green)	90°			X						X				
49.7	joint (brown green)	90°			X						X				
49.7 to 50.8	broken zone(brown,pyrite)				X						X				

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DETAILED DRILL CORE LOGGING

PROJECT... Ear Falls Generating Station .....PROJECT NO.....

SITE .... Powerhouse Floor .....HOLE NO.... 4 .....

.....SHEET NO.... 2 ..OF.... 2 .....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING	PYRITIZED	CARBONACEOUS	
50.8	joint (pyrite)	90°			X								X		
50.83	joint (dark brown)	80°									X				
51.0	joint	80°			X										
51.2	joint	80°			X										
51.25	quartz vein (2" thick)														
51.5	joint (pyrite)	90°											X		
51.54	joint (chlorite, pyrite)	90°		X							X		X		
51.7	joint (pyrite)	85°			X	X							X		80%
52.6	joint (pyrite)	85°			X	X							X		
53.0 to 55.5	quartz veinlets (avg 1/2 in) at 30°-60°														
53.8	joint	90°			X	X									
54.8	joint (pyrite)	90°			X	X							X		
54.3	joint (pyrite)	85°			X	X							X		
55.7	joint (calcified, pyrite)	85°		X		X							X	X	
56.5	joint (pyrite)	30°			X	X							X		
56.5 to 56.8	joint (green, pyrite)	45°		X		X					X		X		
56.9	joint (green, pyrite)	85°			X	X					X		X		
57.8 to 58.2	joint (green, pyrite, calcified)	30°			X	X					X		X	X	78%
58.4	joint (green, pyrite, calcified)	90°		X		X					X			X	
58.42	joint (green, pyrite, calcified)	90°		X		X					X			X	
59.3	joint (pyrite)	75°			X	X							X		
59.6	joint (pyrite, calcified)	90°		X		X							X	X	
59.63	joint (green)	90°			X	X					X				
60.6	End of hole														

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DETAILED DRILL CORE LOGGING

PROJECT Ear Falls Generating Station ..... PROJECT NO. .....

SITE Powerhouse Floor ..... HOLE NO. 5

Bedrock - Medium Grey Gneiss ..... SHEET NO. 1 OF 3

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION													RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING				
0.0	concrete floor															
0.0 to 28.1	concrete															
28.1	concrete/rock contact (rust brown)															
28.2	joint (rust brown, calcified)	65°			X	X					X					
28.4	joint (rust brown, calcified)	90°			X	X					X					
28.6	joint (rust brown, pyrite)	45°			X	X					X					
28.96	joint (rust brown)	90°			X			X			X					
29.8	joint (green brown, pyrite)	80°			X	X					X					
30.1	joint (rust brown, pyrite)	85°			X	X					X					73%
30.8 to 31.1	joint (brownish)	20°			X			X			X					
31.4	joint	90°			X	X										
31.5	joint (yellow brown)	90°			X	X					X					
31.7	joint (yellow brown)	90°			X	X					X					
31.8	joint (yellow brown)	90°				X		X								
32.3	joint (rust brown)	90°				X	X									
34.7	joint	90°				X	X									
35.5	joint (tight)	90°				X	X									
36.0	joint (rust brown)	30°				X	X				X					

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DETAILED DRILL CORE LOGGING

PROJECT.....Ear Falls Generating Station.....PROJECT NO.....

SITE .....Powerhouse Floor.....HOLE NO....5.....

.....SHEET NO....2...OF...3....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
37.1 to 37.2	joint (rust brown,pyrite)	30°			X	X					X				
37.3 to 37.6	joint (rust brown)	25°			X	X					X				
37.6	joint (rust brown)	90°			X	X					X				
38.1	joint (rust brown)	90°			X	X					X				80%
38.2	joint (rust brown)	20°			X	X					X				
38.3	joint (greenish)	90°			X	X					X				
38.7	joint (pyrite)	40°			X	X									
39.3	joint	80°			X			X							
40.1	joint	90°			X	X									
40.5	joint	80°			X	X									
41.1	joint	90°			X			X							
41.9	joint(pyrite)	90°			X	X									
44.2	joint (rust brown)	90°			X	X					X				
44.3	joint	90°			X	X									88%
44.33	joint (yellow green)	90°			X	X					X				
44.4	joint (rust brown)	90°			X	X					X				
44.3 to 44.4	joint (rust brown)	0°			X	X					X				
45.7	joint (brown)	90°			X	X					X				
45.75	joint (brown)	90°			X	X					X				75%
45.8	joint (brown)	90°			X	X					X				
45.9	joint	80°			X			X							

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DETAILED DRILL CORE LOGGING

PROJECT..... Ear Falls Generating Station .....PROJECT NO.....

SITE ..... Powerhouse Floor .....HOLE NO...5.....

.....SHEET NO...3...OF...3....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
46.2	joint (light green)	90°			X	X					X				
46.8	joint (green)	90°			X	X					X				
47.5 to 47.9	broken zone(weathered)														
48.9	joint (calcified)	90°			X	X									
49.0	reference point														
50.8 to 51.7	joint (calcified,pyrite)	10°			X	X									69%
51.7	joint (pyrite)	90°			X	X									
53.2	joint (calcified)	90°			X	X									
53.2 to 53.8	joint (green pyrite)	15°			X	X									
54.2	End of hole														

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DETAILED DRILL CORE LOGGING

PROJECT...Ear Falls Generating Station.....PROJECT NO.....

SITE ....Powerhouse Floor.....HOLE NO...6.....

....Bedrock - Medium Grey Gneiss.....SHEET NO...1...OF.3....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
0.0	concrete floor														
0.0 to 35.7	concrete														
35.7	concrete/rock contact (excellent tight contact)														
36.1	joint (calcified)	75°		X		X									
36.3	joint (rust brown)	50°			X	X					X				
36.4	joint (rust brown)	45°			X	X					X				
36.5	joint (rust brown)	80°			X	X					X				
36.9	joint (green,calcified)	80°			X	X					X				
37.4	joint (pyrite)	80°			X			X							
37.8	joint (pyrite)	80°			X	X									
38.1	joint (pyrite)	35°			X	X									
38.3	joint (rust brown)	90°			X	X					X				
38.8	joint (pyrite)	30°			X			X							
39.3	joint (rust brown)	80°			X	X					X				
39.9	joint (rust brown)	85°			X	X					X				42%
39.92	joint (rust brown)	85°			X	X					X				
40.05	joint (rust brown)	85°			X	X					X				
40.2 to 40.7	joint (rust brown)	25°			X	X					X				
40.5	joint	85°			X	X									
40.8	joint (rust brown)	55°			X	X					X				
40.8 to 41.0	joint	80°			X			X							

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DETAILED DRILL CORE LOGGING

PROJECT..... Ear Falls Generating Station .....PROJECT NO.....

SITE ..... Powerhouse Floor .....HOLE NO....6.....

.....SHEET NO..2..OF..3...

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION												RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING			
41.3	joint	60°			X	X									
41.5	joint	70°			X	X									
41.8	joint	70°			X	X									
42.2	joint (rust brown)	80°			X	X					X				
42.3	joint (rust brown)	80°			X	X					X				
42.5	reference point														
42.8	joint (rust brown)	90°			X	X					X				
42.9	joint (rust brown)	90°			X	X					X				
43.0	joint (rust brown)	80°			X	X					X				
43.3	joint	80°			X	X									
43.4	joint (rust brown)	75°			X	X					X				
43.5	joint (rust brown)	60°			X	X					X				
43.6	joint (rust brown)	75°			X	X					X				
43.8	joint (rust brown)	55°			X	X					X				
44.0	joint (rust brown)	90°			X	X					X				
44.1	joint (rust brown)	90°			X	X					X				
44.2	joint	90°			X	X									
44.3	joint	85°			X	X									
44.5	joint (rust brown)	80°			X	X					X				0%
44.54	joint (calcified)	70°			X	X									
44.8	joint (calcified)	90°			X	X									
44.9	joint	90°			X	X									
45.1	joint (rust brown)	65°			X	X					X				
45.3	joint (rust brown)	90°			X	X					X				
45.6	joint (rust brown)	90°			X	X					X				
45.9	joint	90°			X	X									

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DETAILED DRILL CORE LOGGING

PROJECT... Ear Falls Generating Station ...PROJECT NO.....

SITE ..... Powerhouse Floor ...HOLE NO. 6 .....

.....SHEET NO. 3 OF 3 .....

DEPTH (ft)	DISCONTINUITY (Joint, Fault, Bedding Planes, Cleavage, Lineation)	ANGLE WITH CORE AXIS	DESCRIPTION											RQD
			SLICK	SMOOTH	ROUGH	PLANE	CURVED	IRREGULAR	SLICKENSIDED	FILLING	STAINING	BLEACHING		
46.0 to 46.7	closely broken													
46.7	joint	30°			X	X								
46.7 to 47.5	joint (green, pyrite)	10°			X			X			X			
47.8	reference point													
48.5	joint (calcified)	65°			X	X								
48.7	joint	80°			X	X								
48.8	joint (calcified)	90°			X	X								
48.95	joint (green, calcified)	90°			X	X					X			
49.25	joint (green)	85°			X	X					X			
49.3	joint	30°			X	X								
49.8	joint (green)	90°			X	X					X			
49.83	joint (calcified)	40°			X	X								15%
50.0	joint	50°			X	X								
50.1	joint	60°			X	X								
50.3	joint	70°			X	X								
50.5	joint (calcified)	80°			X	X								
50.8	joint (calcified)	70°			X	X								
50.83	joint	80°			X	X								
51.1	joint	90°												
51.13 - 51.3	joint (grey green, pyrite)	10°			X	X					X			
51.6	End of hole													

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